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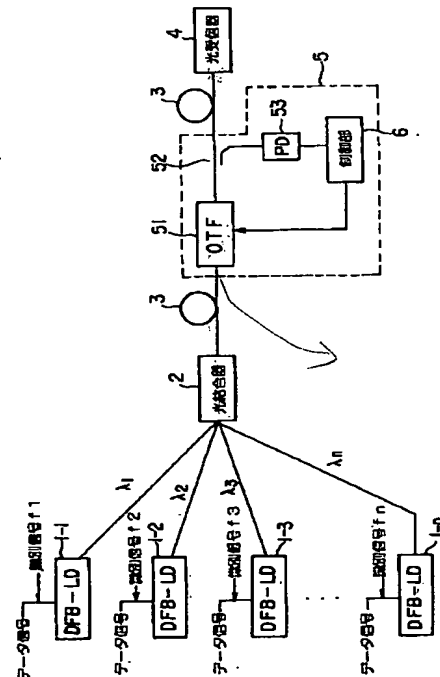
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(54) 【発明の名称】 光通信システムとその光送信器および波長選択器

## (57) 【要約】

【課題】 波長間隔や光パワーレベルにばらつきがある場合においても、クロストークを最小限に抑えながら所望の波長の信号を選択することが可能な光通信システムとその光送信器および波長選択器を提供する。

【解決手段】 予め各チャネルの光信号にそれぞれ周波数が異なる識別信号を重畳したうえで波長多重する。この波長多重光から、可変波長光バンドパスフィルタ (OTF) 51 で所望の波長の光信号を透過させる。このとき、受信チャネルの光信号に重畳された識別信号の振幅が最大になるように OTF 51 のフィルタ特性を制御するようにした。



## 【特許請求の範囲】

【請求項 1】 送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から、受信側で波長選択器により所定の波長の光信号を選択して受信する光通信システムにおいて、

送信側では、予めそれぞれのチャネルの光信号に各々周波数が異なる識別信号を重畳し、受信側では、選択チャネルの光信号に重畳された識別信号の振幅が最大になるように前記波長選択器を制御するようにしたことを特徴とする光通信システム。

【請求項 2】 前記波長選択器は、与えられた制御信号に基づき、前記波長多重光信号から所定の波長の光信号を選択出力する可変波長光バンドパスフィルタと、この可変波長光バンドパスフィルタの出力の一部を分岐して出力する光分岐器と、この光分岐器の出力を光電変換する光電変換器と、この光電変換器の出力に基づき前記可変波長光バンドパスフィルタに制御信号を与える制御手段とを具備することを特徴とする請求項 1 記載の光通信システム。

【請求項 3】 前記制御手段は、与えられた制御信号に応じて、前記光電変換器の出力から受信チャネルの光信号に重畳された識別信号を取り出す可変狭帯域フィルタと、この可変狭帯域フィルタの出力の振幅を取り出す整流器と、所定の低周波信号を出力する発振器と、前記整流器の出力と前記低周波信号とを位相比較する位相比較器と、この位相比較器の出力の低周波成分を取り出すローパスフィルタと、前記発振器が出力する低周波信号に前記ローパスフィルタの出力を加算し、制御信号として前記可変波長光バンドパスフィルタに入力する加算器とを具備することを特徴とする請求項 2 記載の光通信システム。

【請求項 4】 送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から、受信側で波長選択器により所定の波長の光信号を選択して受信する光通信システムにおいて、送信側では、予めそれぞれのチャネルの光信号に、各々周波数が異なる識別信号を重畳し、受信側では、選択チャネルの光信号に重畳された識別信号の振幅と、選択チャネル以外の光信号にそれぞれ重畳された識別信号の振幅の和との比が最大になるように前記波長選択器を制御するようにしたことを特徴とする光通信システム。

【請求項 5】 前記波長選択器は、与えられた制御信号に基づき、前記波長多重光信号から所定の波長の光信号を選択出力する可変波長光バンドパスフィルタと、この可変波長光バンドパスフィルタの出力の一部を分岐

して出力する光分岐器と、

この光分岐器の出力を光電変換する光電変換器と、この光電変換器の出力に基づき前記可変波長光バンドパスフィルタに制御信号を与える制御手段とを具備することを特徴とする請求項 4 記載の光通信システム。

【請求項 6】 前記制御手段は、与えられた制御信号に応じて、前記光電変換器の出力から選択チャネルの光信号に重畳された識別信号を取り出す可変狭帯域フィルタと、

- 10 所定の低周波信号を出力する発振器と、前記光電変換器の出力から、前記可変狭帯域フィルタの出力を減算する減算器と、この減算器の出力と、前記可変狭帯域フィルタの出力との比を求める除算器と、この除算器の出力の振幅を取り出す整流器と、この整流器の出力と前記低周波信号とを位相比較する位相比較器と、この位相比較器の出力の低周波成分を取り出すローパスフィルタと、
- 20 前記発振器が出力する低周波信号に前記ローパスフィルタの出力を加算し、制御信号として前記可変波長光バンドパスフィルタに入力する加算器とを具備することを特徴とする請求項 5 記載の光通信システム。

【請求項 7】 前記制御手段は、前記光電変換器の出力から各々の光信号に重畳された識別信号成分を取り出す複数のフィルタと、これらの複数のフィルタに対して設けられ、それぞれのフィルタの出力から、前記識別信号成分の振幅を取り出す複数の整流器と、

- 30 これらの複数の整流器から出力される各々の識別信号成分の振幅のうち、選択チャネルの光信号に対応するもの以外の和を求めるための加算器と、この加算器の出力と、選択チャネルの光信号に対応する識別信号成分の振幅との比を求める除算器と、この除算器の出力と前記低周波信号とを位相比較する位相比較器と、この位相比較器の出力の低周波成分を取り出すローパスフィルタと、前記発振器が出力する低周波信号に前記ローパスフィルタの出力を加算し、制御信号として前記可変波長光バンドパスフィルタに入力する加算器とを具備することを特徴とする請求項 5 記載の光通信システム。

【請求項 8】 送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から、受信側で波長選択器により所定の波長の光信号を選択して受信する光通信システムで使用される光送信器であって、予めそれぞれのチャネルの光信号に、各々周波数が異なる識別信号を重畳するための手段を具備することを特徴とする光送信器。

- 50 【請求項 9】 予め互いに波長の異なる複数チャネルの

光信号のそれぞれに、各々周波数が異なる識別信号を重畳する光送信器と、送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から、受信側で所定の波長の光信号を選択して受信する光受信器とを備える光通信システムに使用され、前記光受信器内で任意のチャネルの光信号を選択する波長選択器であって、

与えられた制御信号に基づき、前記波長多重光信号から所定の波長の光信号を選択出力する可変波長光バンドパスフィルタと、

この可変波長光バンドパスフィルタの出力の一部を分岐して出力する光分岐器と、

この光分岐器の出力を光電変換する光電変換器と、この光電変換器の出力に基づき前記可変波長光バンドパスフィルタに制御信号を与える制御手段とを具備することを特徴とする波長選択器。

【請求項10】 送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から、受信側で波長選択器により所定の波長の光信号を選択して受信する光通信システムにおいて、送信側では、予めそれぞれのチャネルの光信号に、各々周波数が異なる識別信号を重畳し、受信側では、選択チャネルの光信号に重畳された識別信号の振幅と、選択チャネル以外の光信号にそれぞれ重畳された識別信号の振幅の和との差が最大になるように前記波長選択器を制御するようにしたことを特徴とする光通信システム。

【請求項11】 前記波長選択器は、与えられた制御信号に基づき、前記波長多重光信号から所定の波長の光信号を選択出力する可変波長光バンドパスフィルタと、この可変波長光バンドパスフィルタの出力の一部を分岐して出力する光分岐器と、この光分岐器の出力を光電変換する光電変換器と、この光電変換器の出力に基づき前記可変波長光バンドパスフィルタに制御信号を与える制御手段とを具備することを特徴とする請求項10記載の光通信システム。

【請求項12】 前記制御手段は、与えられた制御信号に応じて、前記光電変換器の出力から選択チャネルの光信号に重畳された識別信号を取り出す可変狭帯域フィルタと、所定の低周波信号を出力する発振器と、前記光電変換器の出力から、前記可変狭帯域フィルタの出力を減算する減算器と、この減算器の出力と、前記可変狭帯域フィルタの出力との差を求める減算器と、この減算器の出力の振幅を取り出す整流器と、この整流器の出力と前記低周波信号とを位相比較する位相比較器と、この位相比較器の出力の低周波成分を取り出すローパスフィルタと、

前記発振器が出力する低周波信号に前記ローパスフィルタの出力を加算し、制御信号として前記可変波長光バンドパスフィルタに入力する加算器とを具備することを特徴とする請求項11記載の光通信システム。

【請求項13】 前記制御手段は、前記光電変換器の出力から各々の光信号に重畳された識別信号成分を取り出す複数のフィルタと、これらの複数のフィルタに対して設けられ、それぞれのフィルタの出力から、前記識別信号成分の振幅を取り出す複数の整流器と、

これらの複数の整流器から出力される各々の識別信号成分の振幅のうち、選択チャネルの光信号に対応するもの以外の和を求めるための加算器と、この加算器の出力と、選択チャネルの光信号に対応する識別信号成分の振幅との差を求める減算器と、この減算器の出力と前記低周波信号とを位相比較する位相比較器と、この位相比較器の出力の低周波成分を取り出すローパスフィルタと、

20 前記発振器が出力する低周波信号に前記ローパスフィルタの出力を加算し、制御信号として前記可変波長光バンドパスフィルタに入力する加算器とを具備することを特徴とする請求項11記載の光通信システム。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、例えば波長多重光通信システムとして実現される光通信システムとその光送信器および波長選択器に関する。

【0002】

30 【従来の技術】近年になり、波長多重光通信システムに関する技術開発が盛んである。このような状況にあつて様々な形態のシステムが開発されているなかで、受信側に波長選択器を備え、波長多重光から所定の波長の光信号を選択して受信するようにしたシステムがある。そのような波長多重光通信システムの一例を図9に示す。

【0003】図9に示す波長多重光通信システムは、それぞれ波長の異なる光信号 $\lambda_1 \sim \lambda_n$ を発振出力する複数の分布帰還形レーザ(DFB-LD)  $1-1 \sim 1-n$ を各々データ信号で駆動し、強度変調された出力光を光結合器2で波長多重して光ファイバ3を介して光受信器4に向け送出する。光受信器4の入力側には波長選択器5が設けられており、外部からの制御信号(図示せず)に応じて波長多重光から所望の波長の光信号を選択して光受信器4に導くようになっている。

【0004】波長選択器5は、例えば音響光学フィルタ、ファブリペロフィルタ、誘電体多層膜フィルタなどの可変波長光バンドパスフィルタ(OTF) 51と、光分岐器52と、フォトダイオード(PD) 53と、制御部54とを備え、OTF 51の出力光を光分岐器52で一部分岐してフォトダイオード53で光電変換し、この

光電変換出力に基づいて制御部54からOTF51に制御信号をフィードバックするものとなっている。

【0005】ところで、周囲の温度変化や経年変化などの影響により、OTF51の中心波長や各チャネルの波長が設定値からずれることがある。これによる受信特性の劣化を避けるため、制御部54に所謂ラインロック機能を設けて受信特性を安定化させるようにしている。

【0006】図10に、制御部54の構成を示す。この制御部54は、位相比較器541と、ローパスフィルタ(LPF)542と、加算器543と、低周波発振器544とを備えている。そして、PD53の出力と低周波発振器544の出力とを位相比較器541で位相比較し、ローパスフィルタ542を介して加算器543に導く。加算器543には、低周波発振器544の出力と外部からの制御電圧が与えられており、これらの加算値をOTF51にフィードバックするようになっている。

【0007】上記構成によれば、運用条件の変化によらず、受信特性を安定化させることが可能となるが、反面、以下のような不具合を伴う。すなわち、上記構成ではOTF51を通過した光信号そのものの強度を見ているため、波長多重光に含まれる各波長の光信号の強度や、波長間隔にばらつきがあった場合にはOTF51の中心波長が所望の値からずれることがあった。

【0008】例えば図11に示すように波長が $\lambda_2$ の光信号にOTF51の特性を合わせようとしても、隣の波長が $\lambda_3$ の光信号の強度が強すぎる場合や、波長間隔が狭すぎる場合には、 $\lambda_3$ の光信号よりもOTF51の中心波長がずれる場合があった。このずれは、光受信器4におけるクロストークの原因になり、受信特性を悪化させることになり好ましくない。

【0009】

【発明が解決しようとする課題】上記したように従来の波長選択器を用いた光通信システムでは、可変波長光バンドパスフィルタを通過する光信号の強度そのものをモニタすることで波長選択器のフィルタ特性を調整していた。このため、波長多重された光信号の波長間隔にばらつきがあったり、強度に差があったりした場合には光フィルタの中心波長が設定値からずれることがあり、クロストークを生じて受信信号が劣化し易いという不具合があった。

【0010】本発明は上記事情によりなされたもので、その目的は、波長間隔や光パワーレベルにばらつきがある場合においても、クロストークを最小限に抑えながら所望の波長の信号を選択することが可能な光通信システムとその光送信器および波長選択器を提供することにある。

【0011】

【課題を解決するための手段】上記目的を達成するために本発明は、送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から受信側で

波長選択器により所定の波長の光信号を選択して受信する光通信システムにおいて、送信側では、予めそれぞれのチャネルの光信号に各々周波数が異なる識別信号を重畳し、受信側では、受信チャネルの光信号に重畳された識別信号の振幅が最大になるように前記波長選択器を制御するようにしたことを特徴とする。

【0012】また本発明は、送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から、受信側で波長選択器により所定の波長の光信号を選択して受信する光通信システムにおいて、送信側では、予めそれぞれのチャネルの光信号に、各々周波数が異なる識別信号を重畳し、受信側では、受信チャネルの光信号に重畳された識別信号の振幅と、受信チャネル以外の光信号にそれぞれ重畳された識別信号の振幅の和との比または差が最大になるように前記波長選択器を制御するようにしたことを特徴とする。

【0013】このようにすれば、波長多重された光信号の波長間隔にばらつきがあったり、強度に差があったりした場合でも、受信側では識別信号に基づいて各チャネルを確実に識別できるようになる。このため、所望の受信チャネルの識別信号レベルの絶対値を最大に、または所望の受信チャネルの識別信号レベルとそれ以外のチャネルのそれぞれの識別信号の和との比または差を最大にすることで、光フィルタの特性を常に最適に調整できるようになる。これにより、クロストークの発生による受信特性の劣化を最小限に抑えることが可能となる。

【0014】

【発明の実施の形態】以下、図面を参照して本発明の実施の形態を詳細に説明する。

(第1の実施の形態) 図1に、本発明の第1の実施の形態に係わる光通信システムの基本的構成を示す。なお、図9と同一部分には同一の符号を付して示し、重複する説明は省略する。

【0015】本実施の形態の光通信システムは、従来の光通信システムとほぼ同様の構成をしているが、各分布帰還形レーザ(DFB-LD)1-1~1-nを駆動するデータ信号に、互いに周波数が異なる識別信号(周波数を $f_1 \sim f_n$ とする)を重畳し、さらに制御部54の構成を変えたものとなっている(符号を6とする)。

【0016】図2に、本実施形態での制御部6の構成を示す。制御部6は、バンドパスフィルタ(BPF)61と、位相比較器62と、ローパスフィルタ(LPF)63と、加算器64と、低周波発振器65と、整流器66とを備えている。そして、外部からの制御信号に応じて、BPF61でフォトダイオード(PD)53の出力から所望の波長の光信号に重畳された識別信号を取り出す。ここでは、波長 $\lambda_k$ の光信号に対応した $f_k$ の識別信号を取り出すものとする。

【0017】整流器66によりこの $f_k$ の識別信号の振

幅成分が取り出され、この振幅成分は低周波発振器 65 が出力する低周波信号 ( $f_{osc}$ ) と共に位相比較器 62 に与えられる。ここで両信号の位相が比較され、その結果が LPF 63 を介して加算器 64 に与えられる。加算器 64 では、低周波発振器 65 の  $f_{osc}$  と LPF 63 の出力とが加算されて可変波長光バンドパスフィルタ (OTF) 51 に与えられるようになっている。このため、OTF 51 のフィルタ特性は LPF 63 の出力を中心として  $f_{osc}$  の周期で移動するようになる。

【0018】図 5 に、OTF 51 のフィルタ特性の移動に伴い、OTF 51 を通過した光信号の位相が変化する様子を示す。例えば OTF 51 のフィルタ特性が  $\lambda_0$  を中心として移動すると、互いに波長のずれた  $\lambda_1$ 、 $\lambda_2$  の波長の光信号は互いに逆位相で出力される。一方、 $\lambda_0$  の光信号は、 $\lambda_1$ 、 $\lambda_2$  の 2 倍の周波数で出力されることになる。

【0019】かくして本実施形態では、予め各チャンネルの光信号にそれぞれ周波数が異なる識別信号を重畳したうえで波長多重する。この波長多重光から、可変波長光バンドパスフィルタ (OTF) 51 で所望の波長の光信号を透過させる。このとき、受信チャンネルの光信号に重畳された識別信号の振幅が最大になるように OTF 51 のフィルタ特性を制御するようにしている。これにより、波長間隔や光パワーレベルにばらつきがある場合においても、可変波長光バンドパスフィルタ (OTF) 51 の中心波長を所望の光信号の波長と正確に合わせることが可能となる。図 6 (a) に、上記構成によるフィルタ特性を示す。ここでは、 $\lambda_2$  の波長の光信号の透過率が最良になるように制御した場合を示す。

【0020】(第 2 の実施の形態) 本実施の形態の光通信システムは、図 1 における制御部 6 の構成を以下のようにしたものとなっている (符号を 7 とする)。図 3 に、本実施形態での制御部 7 の構成を示す。制御部 7 は、バンドパスフィルタ (BPF) 71 と、減算器 72 と、除算器 73 と、位相比較器 74 と、ローパスフィルタ (LPF) 75 と、加算器 76 と、低周波発振器 77 と、整流器 78 とを備えている。

【0021】フォトダイオード (PD) 53 で光電変換された可変波長光バンドパスフィルタ (OTF) 51 の出力は、2 分岐されてそれぞれ BPF 71 と減算器 72 とに与えられる。BPF 71 では、外部からの制御信号に応じて所望の受信チャンネルの光信号に重畳された識別信号が得られる。その出力は 2 分岐され、減算器 72 と除算器 73 とに入力される。減算器 72 では、各チャンネルの識別信号のうち、受信チャンネルの光信号に重畳された識別信号以外の和が出力される。かくして、除算器 73 からは、受信チャンネルの光信号に重畳された識別信号と、それ以外の識別信号の和との比が出力される。

【0022】除算器 73 の出力は、整流器 78 を介してその振幅成分が位相比較器 74 に入力され、以後第 1 の

実施の形態と同様にして受信チャンネルの光信号に重畳された識別信号とそれ以外の識別信号の和との比が最大になるように OTF 51 のフィルタ特性が制御される。このようにすることで、信号/クロストーク比が最大になるように OTF 51 の中心波長を合わせることができ、図 6 (b) に本実施の形態による OTF 51 のフィルタ特性を示す。

【0023】(第 3 の実施の形態) 本実施の形態の光通信システムは、図 1 における制御部 6 の構成を以下のようにしたものとなっている (符号を 8 とする)。図 4 に、本実施形態での制御部 8 の構成を示す。制御部 8 は、各チャンネルに対して設けられ、フォトダイオード (PD) 53 の光電変換出力からそれぞれのチャンネルの識別信号の成分を取り出すフィルタ 81-1 ~ 81-n と、各フィルタ 81-1 ~ 81-n の出力から識別信号の振幅を取り出す整流器 82-1 ~ 82-n と、加算器 83 と、除算器 84 と、位相比較器 85 と、ローパスフィルタ (LPF) 86 と、加算器 87 と、低周波発振器 88 とを備えている。

【0024】加算器 87 には、各整流器 82-1 ~ 82-n の出力のうち、所望の波長 (例えば  $\lambda_2$ ) 以外の光信号の識別信号が与えられる。除算器 84 には、この加算器 87 の出力と、所望の波長 ( $\lambda_2$ ) の光信号の識別信号が入力される。かくして除算器 84 からは、所望の波長  $\lambda_2$  の光信号に重畳された識別信号と、それ以外の識別信号の和との比が出力される。以後第 2 の実施の形態と同様にして、 $\lambda_2$  の光信号に重畳された識別信号とそれ以外の識別信号の和との比が最大になるように可変波長光バンドパスフィルタ (OTF) 51 のフィルタ特性が制御される。このようにすることでも、上記第 2 の実施の形態と同様の効果を得ることができる。

【0025】以上、第 1 ~ 第 3 の実施形態に示したように構成することで、波長間隔や光パワーレベルにばらつきがある場合においても、クロストークを最小限に抑えながら所望の波長の信号を選択することが可能な光通信システムとその光送信器および波長選択器を提供することが可能となる。

【0026】なお、本発明は上記各実施の形態に限定されるものではない。例えば上記第 2 の実施の形態では除算器 73 を設け、受信チャンネルの光信号に重畳された識別信号と、それ以外の識別信号の和との比を求め、この比が最大となるように OTF 51 のフィルタ特性を制御するようにしたが、除算器 73 に換えて減算器を設け、この減算器により受信チャンネルの光信号に重畳された識別信号と、それ以外の識別信号の和との差を求め、この差が最大となるように OTF 51 のフィルタ特性を制御するようにしてもよい。上記作用をもたらす制御部 7 の構成を図 7 に示す (図 3 の除算器 73 を減算器 79 に置き換えたものとなっている)。このようにしても同様の効果を得ることができる。

【0027】第3の実施の形態についても同様に、除算器84に換えて減算器を設け、この減算器により受信チャネルの光信号に重畳された識別信号と、それ以外の識別信号の和との差を求め、この差が最大となるようにOTF51のフィルタ特性を制御するようにしてもよい。上記作用をもたらす制御部8の構成を図8に示す(図4の除算器84を減算器89に置き換えたものとなっている)。このようにしても同様の効果を得ることができる。その他、本発明の要旨を逸脱しない範囲で種々の変形を行うことが可能である。

#### 【0028】

【発明の効果】以上詳述したように本発明では、送信側で互いに波長の異なる複数チャネルの光信号が波長多重された波長多重光信号から受信側で波長選択器により所定の波長の光信号を選択して受信する光通信システムにおいて、送信側で予めそれぞれのチャネルの光信号に各々周波数が異なる識別信号を重畳し、受信側で受信チャネルの光信号に重畳された識別信号の振幅が最大になるように前記波長選択器を制御するようにした。または、受信チャネルの光信号に重畳された識別信号の振幅と、受信チャネル以外の光信号に重畳された識別信号の振幅の和との比が最大になるように前記波長選択器を制御するようにした。

【0029】したがって、波長多重された光信号の波長間隔にばらつきがあったり、強度に差があったりした場合でも、受信側では識別信号に基づいて各チャネルを確実に識別できるようになる。このため、波長選択器の特性を常に最適に調整できるようになり、クロストークの発生による受信特性の劣化を最小限に抑えることが可能となる。

#### 【図面の簡単な説明】

【図1】 本発明の実施の形態に係わる光通信システムの基本的構成を示す回路ブロック図。

【図2】 本発明の第1の実施の形態に係わる制御部6の構成を示す回路ブロック図。

【図3】 本発明の第2の実施の形態に係わる制御部7の構成を示す回路ブロック図。

【図4】 本発明の第3の実施の形態に係わる制御部8の構成を示す回路ブロック図。

【図5】 上記第1乃至第3の実施の形態において、OTF51のフィルタ特性の移動に伴い、OTF51を通過した光信号の位相が変化する様子を示す図。

【図6】 上記第1乃至第3の実施の形態において、OTF51のフィルタ特性が制御される様子を示す図。

【図7】 本発明の第2の実施の形態に係わる制御部7の構成の他の例を示す回路ブロック図。

【図8】 本発明の第3の実施の形態に係わる制御部8の構成の他の例を示す回路ブロック図。

【図9】 従来の光通信システムの基本的構成を示す回

路ブロック図。

【図10】 従来の光通信システムの制御部54の構成を示す回路ブロック図。

【図11】 従来の光通信システムの不具合を示すために用いた図。

#### 【符号の説明】

1-1~1-n…分布帰還形レーザ(DFB-LD)

$\lambda_1 \sim \lambda_n$ …光信号

2…光結合器

10 3…光ファイバ

4…光受信器

5…波長選択器

51…可変波長光バンドパスフィルタ(OTF)

52…光分岐器

53…フォトダイオード(PD)

54…従来構成の制御部

541…位相比較器

542…ローパスフィルタ(LPF)

543…加算器

20 544…低周波発振器

$f_1 \sim f_n$ …識別信号とその周波数

6…第1の実施の形態の制御部

61…バンドパスフィルタ(BPF)

62…位相比較器

63…ローパスフィルタ(LPF)

64…加算器

65…低周波発振器

66…整流器

7…第2の実施の形態の制御部

30 71…バンドパスフィルタ(BPF)

72…減算器

73…除算器

74…位相比較器

75…ローパスフィルタ(LPF)

76…加算器

77…低周波発振器

78…整流器

79…減算器

8…第3の実施の形態の制御部

40 81-1~81-n…フィルタ

82-1~82-n…整流器

83…加算器

84…除算器

85…位相比較器

86…ローパスフィルタ(LPF)

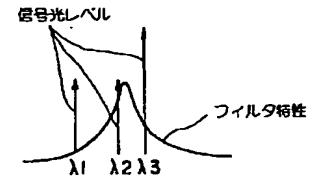
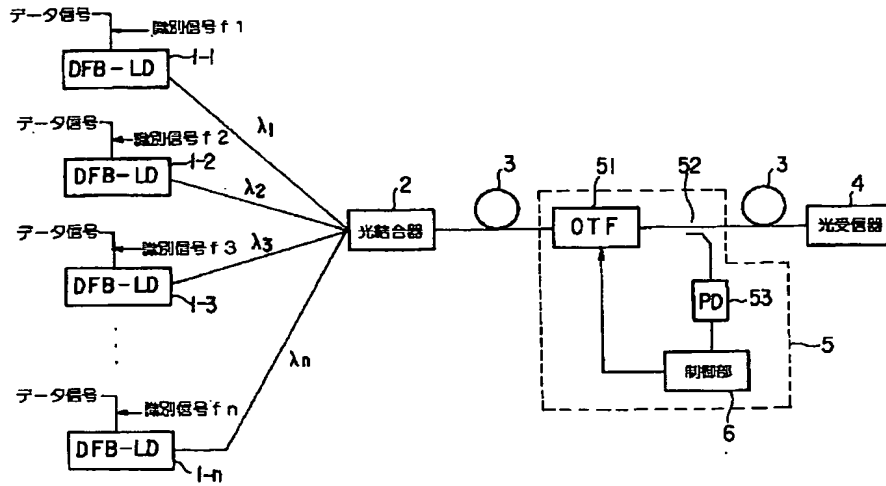
87…加算器

88…低周波発振器

89…減算器

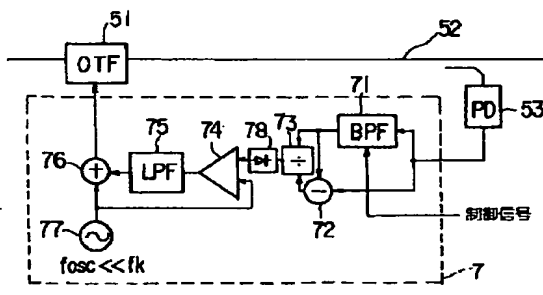
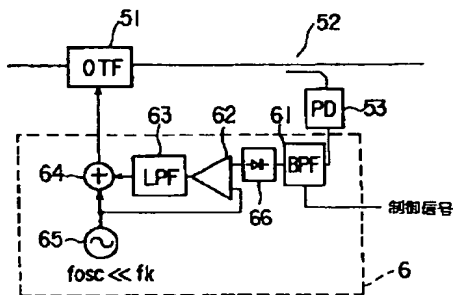
【図 1】

【図 1 1】



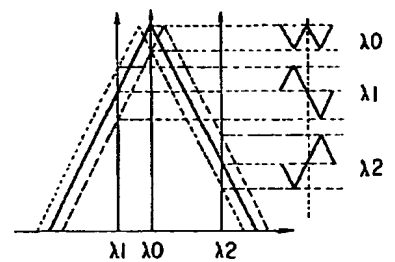
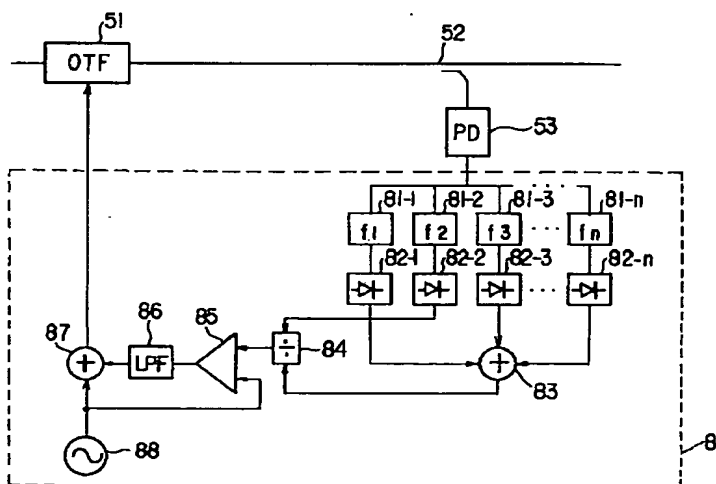
【図 2】

【図 3】

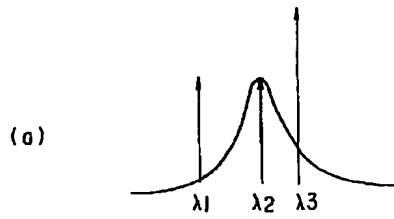


【図 4】

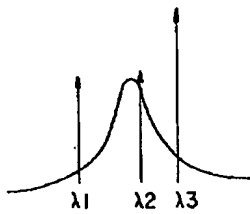
【図 5】



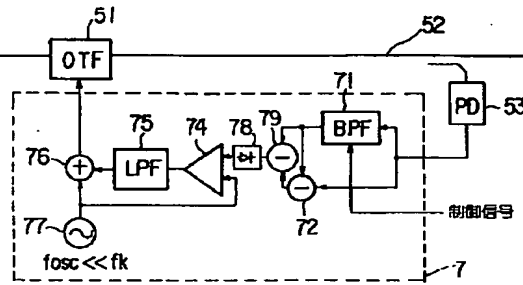
【図 6】



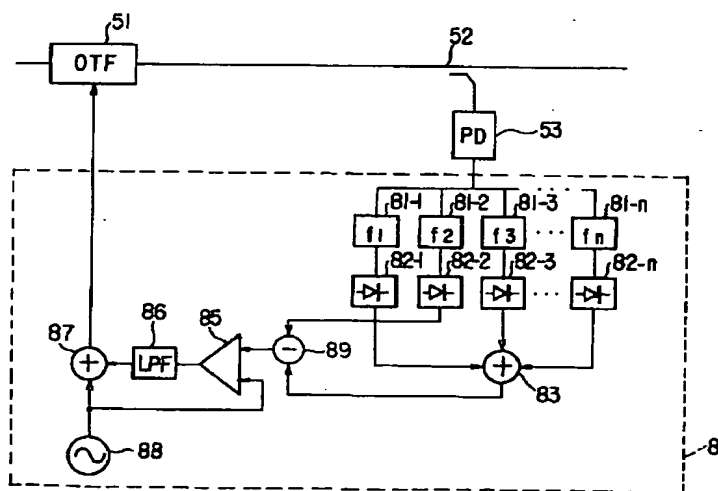
(b)



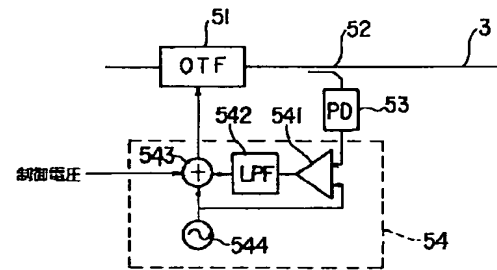
【図 7】



【図 8】

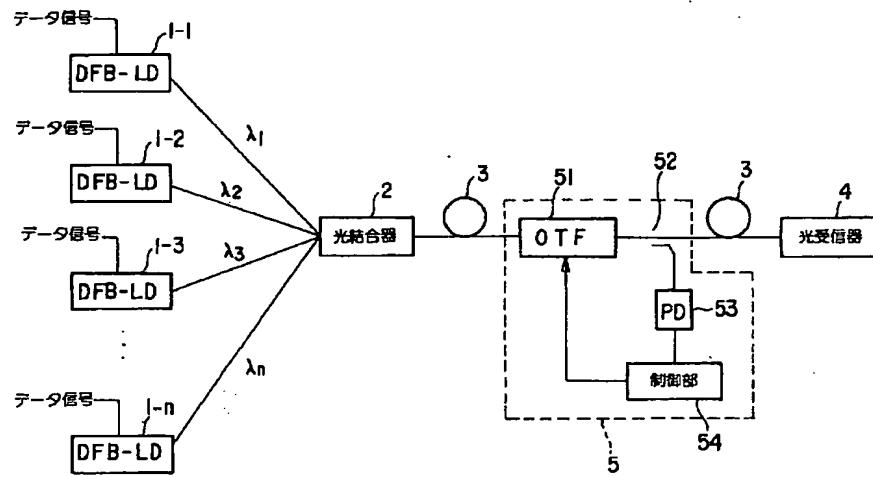


【図 10】





【図 9】



# PATENT ABSTRACTS OF JAPAN

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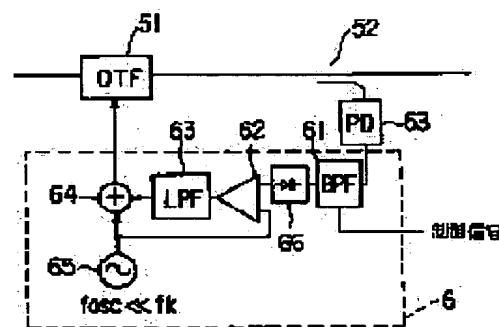
(72)Inventor : MANNISH SHARMA

## (54) OPTICAL COMMUNICATION SYSTEM, ITS OPTICAL TRANSMITTER AND WAVELENGTH SELECTOR

(57)Abstract:

**PROBLEM TO BE SOLVED:** To select the signal of a desired wavelength while crosstalk is suppressed to a minimum by previously overlapping identification signals having different frequencies with the light signals of respective channels on a transmission side and controlling a wavelength selector so that the amplitude of the identification signal becomes maximum on a reception side.

**SOLUTION:** The identification signal of  $f_k$ , which is overlapped with the light signal of the desired wavelength, and which corresponds to the light signal of wavelength  $\lambda_k$ , for example, is taken out from output of PD 53 in BPF 61 in accordance with a control signal from the outside. The amplitude component of the identification signal of  $f_k$ , which is taken out in a rectifier 66, is given to a phase shifter 62 with a low frequency signal  $f_{osc}$  from a low frequency oscillator 65. The phases of both signals are compared and the result is given to an adder 64 through LPF 63. An adder 64 adds  $f_{osc}$  of the low frequency oscillator 65 to the output of LPF 63 and the value is given to a variable wavelength light band pass filter OTF 51.



## LEGAL STATUS

[Date of request for examination]

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[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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**CLAIMS**

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**[Claim(s)]**

[Claim 1] An optical transmission system characterized by to control said wavelength selection machine so that amplitude of a recognition signal on which a recognition signal with which frequency differs respectively in a lightwave signal of each channel beforehand by transmitting side in an optical transmission system which chooses a lightwave signal of predetermined wavelength with a wavelength selection vessel, and is received by receiving side was superimposed from a wavelength-multiplexing lightwave signal with which wavelength multiplexing of the lightwave signal of a multiple channel with which wavelength differs mutually by transmitting side was carried out, and a lightwave signal of a selector channel was overlapped in a receiving side becomes max.

[Claim 2] Said wavelength selection machine is the optical transmission system according to claim 1 characterized by to provide an adjustable wavelength light band pass filter which carries out the selection output of the lightwave signal of predetermined wavelength from said wavelength-multiplexing lightwave signal, an optical turnout which branches and outputs a part of output of this adjustable wavelength light band pass filter, an optical/electrical converter which carries out photo electric conversion of the output of this optical turnout, and a control means which gives a control signal to said adjustable wavelength light band pass filter based on an output of this optical/electrical converter based on a given control signal.

[Claim 3] An optical transmission system according to claim 2 characterized by providing the following. Said control means is an adjustable narrow band filter which takes out a recognition signal on which a lightwave signal of a receiving channel was overlapped from an output of said optical/electrical converter according to a given control signal. A rectifier which takes out amplitude of an output of this adjustable narrow band filter. An oscillator which outputs a predetermined low frequency signal. A phase comparator which carries out the phase comparison of an output and said low frequency signal of said rectifier, a low pass filter which takes out a low-frequency component of an output of this phase comparator, and an adder which adds an output of said low pass filter to a low frequency signal which said oscillator outputs, and is inputted into said adjustable wavelength light band pass filter as a control signal.

[Claim 4] In an optical transmission system which chooses a lightwave signal of predetermined wavelength with a wavelength selection vessel, and is received by receiving side by transmitting side from a wavelength multiplexing lightwave signal with which wavelength multiplexing of the lightwave signal of a multiple channel with which wavelength differs mutually was carried out. In a transmitting side, a recognition signal with which frequency differs respectively is beforehand superimposed on a lightwave signal of each channel. In a receiving side, an optical transmission system characterized by controlling said wavelength selection machine so that a ratio with the sum of amplitude of a recognition signal on which a lightwave signal of a selector channel was overlapped, and amplitude of a recognition signal on which lightwave signals other than a selector channel were overlapped, respectively becomes max.

[Claim 5] Said wavelength selection machine is the optical transmission system according to claim 4 characterized by to provide an adjustable wavelength light band pass filter which carries out the selection output of the lightwave signal of predetermined wavelength from said wavelength-multiplexing lightwave signal, an optical turnout which branches and outputs a part of output of this adjustable wavelength light band pass filter, an optical/electrical converter which carries out photo electric conversion of the output of this optical turnout, and a control means which gives a control signal to said adjustable wavelength light band pass filter based on an output of this optical/electrical converter based on a given control signal.

[Claim 6] An optical transmission system according to claim 5 characterized by providing the following. Said control means is an adjustable narrow band filter which takes out a recognition signal

on which a lightwave signal of a selector channel was overlapped from an output of said optical/electrical converter according to a given control signal. An oscillator which outputs a predetermined low frequency signal A subtractor which subtracts an output of said adjustable narrow band filter from an output of said optical/electrical converter A phase comparator which carries out the phase comparison of a divider which asks for a ratio of an output of this subtractor, and an output of said adjustable narrow band filter, a rectifier which takes out amplitude of an output of this divider, and an output and said low frequency signal of this rectifier, a low pass filter which takes out a low-frequency component of an output of this phase comparator, and an adder which adds an output of said low pass filter to a low frequency signal which said oscillator outputs, and is inputted into said adjustable wavelength light band pass filter as a control signal

[Claim 7] An optical transmission system according to claim 5 characterized by providing the following. Said control means are two or more filters which take out a recognition signal component on which each lightwave signal was overlapped from an output of said optical/electrical converter. Two or more rectifiers which are formed to two or more of these filters, and take out amplitude of said recognition signal component from an output of each filter An adder for asking for the sums other than a thing corresponding to a lightwave signal of a selector channel among amplitude of each recognition signal component outputted from two or more of these rectifiers A phase comparator which carries out the phase comparison of a divider which asks for a ratio of an output of this adder, and amplitude of a recognition signal component corresponding to a lightwave signal of a selector channel, and an output and said low frequency signal of this divider, a low pass filter which takes out a low-frequency component of an output of this phase comparator, and an adder which adds an output of said low pass filter to a low frequency signal which said oscillator outputs, and is inputted into said adjustable wavelength light band pass filter as a control signal

[Claim 8] An optical transmitter which is an optical transmitter used with an optical transmission system which chooses a lightwave signal of predetermined wavelength from a wavelength multiplexing lightwave signal with which wavelength multiplexing of the lightwave signal of a multiple channel with which wavelength differs mutually by transmitting side was carried out with a wavelength selection vessel by receiving side, and is received, and is characterized by providing a means for superimposing beforehand a recognition signal with which frequency differs respectively in a lightwave signal of each channel.

[Claim 9] the wavelength selection machine which is used for an optical transmission system equipped with the optical receiver which chooses the lightwave signal of wavelength predetermined by receiving side, and receives from the wavelength-multiplexing lightwave signal with which the wavelength multiplexing of the lightwave signal of a multiple channel with which wavelength differs mutually by the optical transmitter which superimposes a recognition signal with which it is alike with a recognition signal, respectively and each frequency differs and the transmitting side of the lightwave signal of a multiple channel which is characterized by to provide the following, and with which wavelength differs mutually beforehand be carried out, and chooses the lightwave signal of the channel of arbitration within said optical receiver An adjustable wavelength light band pass filter which carries out the selection output of the lightwave signal of predetermined wavelength from said wavelength multiplexing lightwave signal based on a given control signal An optical turnout which branches and outputs a part of output of this adjustable wavelength light band pass filter An optical/electrical converter which carries out photo electric conversion of the output of this optical turnout A control means which gives a control signal to said adjustable wavelength light band pass filter based on an output of this optical/electrical converter

[Claim 10] In an optical transmission system which chooses a lightwave signal of predetermined wavelength with a wavelength selection vessel, and is received by receiving side by transmitting side from a wavelength multiplexing lightwave signal with which wavelength multiplexing of the lightwave signal of a multiple channel with which wavelength differs mutually was carried out In a transmitting side, a recognition signal with which frequency differs respectively is beforehand superimposed on a lightwave signal of each channel. In a receiving side An optical transmission system characterized by controlling said wavelength selection machine so that a difference with the sum of amplitude of a recognition signal on which a lightwave signal of a selector channel was overlapped, and amplitude of a recognition signal on which lightwave signals other than a selector channel were overlapped, respectively becomes max.

[Claim 11] Said wavelength selection machine is the optical transmission system according to claim 10 characterized by to provide an adjustable wavelength light band pass filter which carries out the selection output of the lightwave signal of predetermined wavelength from said wavelength-multiplexing lightwave signal, an optical turnout which branches and outputs a part of output of this

adjustable wavelength light band pass filter, an optical/electrical converter which carries out photo electric conversion of the output of this optical turnout, and a control means which gives a control signal to said adjustable wavelength light band pass filter based on an output of this optical/electrical converter based on a given control signal.

[Claim 12] An optical transmission system according to claim 11 characterized by providing the following. Said control means is an adjustable narrow band filter which takes out a recognition signal on which a lightwave signal of a selector channel was overlapped from an output of said optical/electrical converter according to a given control signal. An oscillator which outputs a predetermined low frequency signal A subtractor which subtracts an output of said adjustable narrow band filter from an output of said optical/electrical converter A phase comparator which carries out the phase comparison of a subtractor which searches for a difference of an output of this subtractor, and an output of said adjustable narrow band filter, a rectifier which takes out amplitude of an output of this subtractor, and an output and said low frequency signal of this rectifier, a low pass filter which takes out a low-frequency component of an output of this phase comparator, and an adder which adds an output of said low pass filter to a low frequency signal which said oscillator outputs, and is inputted into said adjustable wavelength light band pass filter as a control signal

[Claim 13] An optical transmission system according to claim 11 characterized by providing the following. Said control means are two or more filters which take out a recognition signal component on which each lightwave signal was overlapped from an output of said optical/electrical converter. Two or more rectifiers which are formed to two or more of these filters, and take out amplitude of said recognition signal component from an output of each filter An adder for asking for the sums other than a thing corresponding to a lightwave signal of a selector channel among amplitude of each recognition signal component outputted from two or more of these rectifiers A phase comparator which carries out the phase comparison of a subtractor which searches for a difference of an output of this adder, and amplitude of a recognition signal component corresponding to a lightwave signal of a selector channel, and an output and said low frequency signal of this subtractor, a low pass filter which takes out a low-frequency component of an output of this phase comparator, and an adder which adds an output of said low pass filter to a low frequency signal which said oscillator outputs, and is inputted into said adjustable wavelength light band pass filter as a control signal

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the optical transmission system realized as for example, a wavelength-multiplex-optical-telecommunications system, its optical transmitter, and a wavelength selector.

[0002]

[Description of the Prior Art] Recent years come and the ED about a wavelength-multiplex-optical-telecommunications system is prosperous. There is a system which equips a receiving side with a wavelength selector, chooses the lightwave signal of predetermined wavelength from wavelength multiplexing light while being in such a situation and developing the system of various gestalten, and was received. An example of such a wavelength-multiplex-optical-telecommunications system is shown in drawing 9.

[0003] The wavelength-multiplex-optical-telecommunications system shown in drawing 9 drives respectively two or more distribution feedback form laser (DFB-LD) 1-1 which carries out the oscillation output of the lightwave signal  $\lambda_1$  with which wavelength differs, respectively - the  $\lambda_{1-n}$  with a data signal, carries out wavelength multiplexing of the output light by which intensity modulation was carried out with the optical coupling vessel 2, and sends it out towards the optical receiver 4 through an optical fiber 3. The wavelength selector 5 is formed in the input side of the optical receiver 4, and the lightwave signal of desired wavelength is chosen from wavelength multiplexing light according to the control signal (not shown) from the outside, and it leads to the optical receiver 4.

[0004] wavelength -- a selector -- five -- for example, -- an acoustooptic filter -- Fabry-Perot -- a filter -- a dielectric -- a multilayer -- a filter -- etc. -- adjustable -- wavelength -- light -- a band pass filter (OTF) -- 51 -- light -- a turnout -- 52 -- a photodiode -- (PD) -- 53 -- a control section -- 54 -- having -- OTF -- 51 -- an output -- light -- light -- a turnout -- 52 -- a part -- branching -- a photodiode -- 53 -- photo electric translation -- carrying out -- this -- photo electric translation -- an output -- being based -- a control section -- 54 -- from -- OTF -- 51 -- a control signal -- feeding back -- a thing -- becoming -- \*\*\*\*.

[0005] By the way, the main wavelength of OTF51 and the wavelength of each channel may shift from the set point under the effect of a surrounding temperature change, secular change, etc. In order to avoid degradation of the receiving property by this, he prepares the so-called line lock function in a control section 54, and is trying to stabilize a receiving property.

[0006] The configuration of a control section 54 is shown in drawing 10. This control section 54 is equipped with the phase comparator 541, the low pass filter (LPF) 542, the adder 543, and the audio frequency oscillator 544. And the phase comparison of the output of PD53 and the output of an audio frequency oscillator 544 is carried out with a phase comparator 541, and it leads to an adder 543 through a low pass filter 542. The control voltage from the output and the outside of an audio frequency oscillator 544 is given to the adder 543, and these aggregate values are fed back to OTF51.

[0007] According to the above-mentioned configuration, it becomes possible not to be based on change of employment conditions but to stabilize a receiving property, but on the other hand, it is accompanied by the following nonconformities. That is, with the above-mentioned configuration, since the reinforcement of the lightwave signal itself which passed OTF51 was seen, when dispersion was in the reinforcement and wavelength spacing of a lightwave signal of each wavelength contained in wavelength multiplexing light, the main wavelength of OTF51 might shift from the desired value.

[0008] For example, as shown in drawing 11, even if wavelength tended to double the property of OTF51 with the lightwave signal of  $\lambda_2$ , there were a case where the next wavelength of the

reinforcement of the lightwave signal of  $\lambda_3$  is too strong, and a case where the main wavelength of OTF51 shifted to the lightwave signal of  $\lambda_3$  when wavelength spacing is too narrow. This gap causes a cross talk in the optical receiver 4, makes a receiving property get worse, and is not desirable.

[0009]

[Problem(s) to be Solved by the Invention] As described above, the optical transmission system using the conventional wavelength selector was adjusting the filter shape of a wavelength selector by carrying out the monitor of the reinforcement of a lightwave signal itself which passes an adjustable wavelength light band pass filter. For this reason, when dispersion was in wavelength spacing of the lightwave signal by which wavelength multiplexing was carried out or a difference was in reinforcement, there was nonconformity that the main wavelength of an optical filter might shift from the set point, produced a cross talk, and an input signal tends to deteriorate.

[0010] This invention was made according to the above-mentioned situation, and the object is in offering the optical transmission system which can choose the signal of desired wavelength, its optical transmitter, and a wavelength selector, stopping a cross talk to the minimum, when dispersion is in wavelength spacing or optical power level.

[0011]

[Means for Solving the Problem] In the optical transmission system which this invention chooses the lightwave signal of predetermined wavelength by the wavelength selector, and receives it by the receiving side from the wavelength multiplexing lightwave signal with which wavelength multiplexing of the lightwave signal of a multiple channel with which wavelength differs mutually by the transmitting side was carried out in order to attain the above-mentioned object It is characterized by controlling said wavelength selector by the transmitting side so that the amplitude of the recognition signal on which the recognition signal with which frequencies differ respectively was beforehand superimposed on the lightwave signal of each channel, and the lightwave signal of a receiving channel was overlapped in the receiving side becomes max.

[0012] Moreover, this invention is set to the optical transmission system which chooses the lightwave signal of predetermined wavelength by the wavelength selector, and is received by the receiving side from the wavelength multiplexing lightwave signal with which wavelength multiplexing of the lightwave signal of a multiple channel with which wavelength differs mutually by the transmitting side was carried out. In a transmitting side, the recognition signal with which frequencies differ respectively is beforehand superimposed on the lightwave signal of each channel. In a receiving side It is characterized by controlling said wavelength selector so that the ratio or difference with the sum of the amplitude of the recognition signal on which the lightwave signal of a receiving channel was overlapped, and the amplitude of the recognition signal on which lightwave signals other than a receiving channel were overlapped, respectively becomes max.

[0013] Even when doing in this way, and dispersion is in wavelength spacing of the lightwave signal by which wavelength multiplexing was carried out or a difference is in reinforcement, in a receiving side, each channel can be certainly identified based on a recognition signal. For this reason, the property of an optical filter can always be adjusted now the optimal by making the ratio or difference of the recognition signal level of max or a desired receiving channel, and the sum of each recognition signal of the other channel become max about the absolute value of the recognition signal level of a desired receiving channel. This becomes possible to suppress degradation of the receiving property by generating of a cross talk to the minimum.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

(Gestalt of the 1st operation) The fundamental configuration of the optical transmission system concerning the gestalt of operation of the 1st of this invention is shown in drawing 1 . In addition, the same sign is given to the same part as drawing 9 , it is shown and the overlapping explanation is omitted.

[0015] Although the optical transmission system of the gestalt of this operation is carrying out the almost same configuration as the conventional optical transmission system, it superimposes the recognition signal (a frequency is set to  $f_1$ – $f_n$ ) with which frequencies differ mutually on the data signal which drives each distribution feedback form laser (DFB-LD) 1–1 – 1– $n$ , and has become what changed the configuration of a control section 54 further (a sign is set to 6).

[0016] The configuration of the control section 6 in this operation gestalt is shown in drawing 2 . The control section 6 is equipped with a band pass filter (BPF) 61, a phase comparator 62, the low pass filter (LPF) 63, the adder 64, the audio frequency oscillator 65, and the rectifier 66. And according to

the control signal from the outside, the recognition signal on which the lightwave signal of desired wavelength was overlapped from the output of a photodiode (PD) 53 by BPF61 is taken out. Here, the recognition signal of  $f_k$  corresponding to the lightwave signal of wavelength  $\lambda_{dk}$  shall be taken out.

[0017] The amplitude component of this recognition signal of  $f_k$  is taken out by the rectifier 66, and this amplitude component is given to a phase comparator 62 with the low frequency signal ( $f_{osc}$ ) which an audio frequency oscillator 65 outputs. The phase of both signals is compared here and the result is given to an adder 64 through LPF63. In an adder 64,  $f_{osc}$  of an audio frequency oscillator 65 and the output of LPF63 are added, and the adjustable wavelength light band pass filter (OTF) 51 is given. For this reason, the filter shape of OTF51 comes to move with the period of  $f_{osc}$  focusing on the output of LPF63.

[0018] Signs that the phase of the lightwave signal which passed OTF51 with migration of the filter shape of OTF51 changes to drawing 5 are shown. For example, if the filter shape of OTF51 moves  $\lambda_0$  as a core, the lightwave signal of the wavelength of  $\lambda_1$  and  $\lambda_2$  with which wavelength shifted mutually will be mutually outputted by the opposite phase. On the other hand, the lightwave signal of  $\lambda_0$  will be outputted on the twice as many frequency of  $\lambda_1$  and  $\lambda_2$  as this.

[0019] In this way, with this operation gestalt, after superimposing beforehand the recognition signal with which frequencies differ, respectively on the lightwave signal of each channel, wavelength multiplexing is carried out. The lightwave signal of desired wavelength is made to penetrate with the adjustable wavelength light band pass filter (OTF) 51 from this wavelength multiplexing light. He is trying to control the filter shape of OTF51 at this time, so that the amplitude of the recognition signal on which the lightwave signal of a receiving channel was overlapped becomes max. Thereby, when dispersion is in wavelength spacing or optical power level, it becomes possible to double the main wavelength of the adjustable wavelength light band pass filter (OTF) 51 with the desired wavelength and the accuracy of a lightwave signal. The filter shape by the above-mentioned configuration is shown in drawing 6 (a). Here, the case where it controls so that the permeability of the lightwave signal of the wavelength of  $\lambda_2$  becomes best is shown.

[0020] (Gestalt of the 2nd operation) The optical transmission system of the gestalt of this operation is what performed as follows the configuration of the control section 6 in drawing 1 (a sign is set to 7). The configuration of the control section 7 in this operation gestalt is shown in drawing 3. The control section 7 is equipped with a band pass filter (BPF) 71, a subtractor 72, a divider 73, a phase comparator 74, the low pass filter (LPF) 75, the adder 76, the audio frequency oscillator 77, and the rectifier 78.

[0021] The output of the adjustable wavelength light band pass filter (OTF) 51 by which photo electric translation was carried out with the photodiode (PD) 53 dichotomizes, and participates in BPF71 and a subtractor 72, respectively. In BPF71, the recognition signal on which the lightwave signal of a desired receiving channel was overlapped according to the control signal from the outside is acquired. The output dichotomizes and is inputted into a subtractor 72 and a divider 73. In a subtractor 72, the sums other than the recognition signal on which the lightwave signal of a receiving channel was overlapped among the recognition signals of each channel are outputted. In this way, from a divider 73, the ratio of the recognition signal on which the lightwave signal of a receiving channel was overlapped, and the sum of the other recognition signal is outputted.

[0022] The filter shape of OTF51 is controlled so that a ratio with the sum of the recognition signal on which the amplitude component was inputted into the phase comparator 74 through the rectifier 78, and the output of a divider 73 was superimposed by the lightwave signal of a receiving channel like the gestalt of the 1st operation after that, and the other recognition signal becomes max. By doing in this way, the main wavelength of OTF51 can be doubled so that a signal / cross talk ratio may become max. The filter shape of OTF51 by the gestalt of this operation is shown in drawing 6 (b).

[0023] (Gestalt of the 3rd operation) The optical transmission system of the gestalt of this operation is what performed as follows the configuration of the control section 6 in drawing 1 (a sign is set to 8). The configuration of the control section 8 in this operation gestalt is shown in drawing 4. The filter 81-1 which a control section 8 is formed to each channel, and takes out the component of the recognition signal of each channel from the photo-electric-translation output of a photodiode (PD) 53 - 81-n. It has the rectifier 82-1 which takes out the amplitude of a recognition signal from the output of each filter 81-1 - 81-n - 82-n, an adder 83, a divider 84, the phase comparator 85, the low pass filter (LPF) 86, the adder 87, and the audio frequency oscillator 88.

[0024] The recognition signal of lightwave signals other than desired wavelength (for example,  $\lambda_{da}$ )



2) is given to an adder 87 among the outputs of each rectifier 82-1 - 82-n. The recognition signal of the lightwave signal of the output of this adder 87 and desired wavelength ( $\lambda_2$ ) is inputted into a divider 84. From a divider 84, the ratio of the recognition signal on which the lightwave signal of the desired wavelength  $\lambda_2$  was overlapped, and the sum of the other recognition signal is outputted in this way. Henceforth, like the gestalt of the 2nd operation, the filter shape of the adjustable wavelength light band pass filter (OTF) 51 is controlled so that a ratio with the sum of the recognition signal on which the lightwave signal of  $\lambda_2$  was overlapped, and the other recognition signal becomes max. The effectiveness as the gestalt of implementation of the above 2nd also with same also doing in this way can be acquired.

[0025] as mentioned above, the 1- it becomes possible to offer the optical transmission system which can choose the signal of desired wavelength, its optical transmitter, and a wavelength selector, stopping a cross talk with constituting, as shown in the 3rd operation gestalt, to the minimum, when dispersion is in wavelength spacing or optical power level.

[0026] In addition, this invention is not limited to the gestalt of each above-mentioned implementation. For example, although the filter shape of OTF51 was controlled by the gestalt of implementation of the above 2nd so that a divider 73 was formed, it asked for the ratio of the recognition signal on which the lightwave signal of a receiving channel was overlapped, and the sum of the other recognition signal and this ratio served as max. It changes to a divider 73, a subtractor is formed, the difference of the recognition signal on which the lightwave signal of a receiving channel was overlapped by this subtractor, and the sum of the other recognition signal is searched for, and you may make it control the filter shape of OTF51 so that this difference serves as max. The configuration of the control section 7 which brings about the above-mentioned operation is shown in drawing 7 (it is what transposed the divider 73 of drawing 3 to the subtractor 79). The same effectiveness can be acquired even if such.

[0027] It changes to a divider 84 similarly about the gestalt of the 3rd operation, a subtractor is formed, the difference of the recognition signal on which the lightwave signal of a receiving channel was overlapped by this subtractor, and the sum of the other recognition signal is searched for, and you may make it control the filter shape of OTF51 so that this difference serves as max. The configuration of the control section 8 which brings about the above-mentioned operation is shown in drawing 8 (it is what transposed the divider 84 of drawing 4 to the subtractor 89). The same effectiveness can be acquired even if such. In addition, it is possible to perform deformation various in the range which does not deviate from the summary of this invention.

[0028]

[Effect of the Invention] Said wavelength selector was controlled so that the amplitude of the recognition signal on which the recognition signal with which frequencies differ respectively in the lightwave signal of each channel beforehand by the transmitting side in the optical transmission system which chooses the lightwave signal of predetermined wavelength by the wavelength selector by the wavelength multiplexing lightwave signal to which wavelength multiplexing of the lightwave signal of the multiple channel from which wavelength differs mutually [ in this invention ] at a transmitting side as explained in full detail above was carried out to the receiving side, and is received was superimposed, and the lightwave signal of a receiving channel was overlapped by the receiving side became max. Or said wavelength selector was controlled so that a ratio with the sum of the amplitude of the recognition signal on which the lightwave signal of a receiving channel was overlapped, and the amplitude of the recognition signal on which lightwave signals other than a receiving channel were overlapped became max.

[0029] Therefore, even when dispersion is in wavelength spacing of the lightwave signal by which wavelength multiplexing was carried out or a difference is in reinforcement, in a receiving side, each channel can be certainly identified based on a recognition signal. For this reason, the property of a wavelength selector can always be adjusted now the optimal, and it becomes possible to suppress degradation of the receiving property by generating of a cross talk to the minimum.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

[Drawing 1] The circuit block diagram showing the fundamental configuration of the optical transmission system concerning the gestalt of operation of this invention.

[Drawing 2] The circuit block diagram showing the configuration of the control section 6 concerning the gestalt of operation of the 1st of this invention.

[Drawing 3] The circuit block diagram showing the configuration of the control section 7 concerning the gestalt of operation of the 2nd of this invention.

[Drawing 4] The circuit block diagram showing the configuration of the control section 8 concerning the gestalt of operation of the 3rd of this invention.

[Drawing 5] Drawing showing signs that the phase of the lightwave signal which passed OTF51 changes with migration of the filter shape of OTF51 in the gestalt of the above 1st thru/or the 3rd implementation.

[Drawing 6] Drawing showing signs that the filter shape of OTF51 is controlled, in the gestalt of the above 1st thru/or the 3rd implementation.

[Drawing 7] The circuit block diagram showing other examples of the configuration of the control section 7 concerning the gestalt of operation of the 2nd of this invention.

[Drawing 8] The circuit block diagram showing other examples of the configuration of the control section 8 concerning the gestalt of operation of the 3rd of this invention.

[Drawing 9] The circuit block diagram showing the fundamental configuration of the conventional optical transmission system.

[Drawing 10] The circuit block diagram showing the configuration of the control section 54 of the conventional optical transmission system.

[Drawing 11] Drawing used in order to show the fault of the conventional optical transmission system.

**[Description of Notations]**

1-1 - 1-n -- Distribution feedback form laser (DFB-LD)

$\lambda_1$ - $\lambda_n$  -- Lightwave signal

2 -- Optical coupling machine

3 -- Optical fiber

4 -- Optical receiver

5 -- Wavelength selection machine

51 -- Adjustable wavelength light band pass filter (OTF)

52 -- Optical turnout

53 -- Photodiode (PD)

54 -- Control section of the conventional configuration

541 -- Phase comparator

542 -- Low pass filter (LPF)

543 -- Adder

544 -- Audio frequency oscillator

$f_1$ - $f_n$  -- A recognition signal and its frequency

6 -- Control section of the gestalt of the 1st operation

61 -- Band pass filter (BPF)

62 -- Phase comparator

63 -- Low pass filter (LPF)

64 -- Adder

65 -- Audio frequency oscillator

66 -- Rectifier

7 -- Control section of the gestalt of the 2nd operation  
71 -- Band pass filter (BPF)  
72 -- Subtractor  
73 -- Divider  
74 -- Phase comparator  
75 -- Low pass filter (LPF)  
76 -- Adder  
77 -- Audio frequency oscillator  
78 -- Rectifier  
79 -- Subtractor  
8 -- Control section of the gestalt of the 3rd operation  
81-1 - 81-n -- Filter  
82-1 - 82-n -- Rectifier  
83 -- Adder  
84 -- Divider  
85 -- Phase comparator  
86 -- Low pass filter (LPF)  
87 -- Adder  
88 -- Audio frequency oscillator  
89 -- Subtractor

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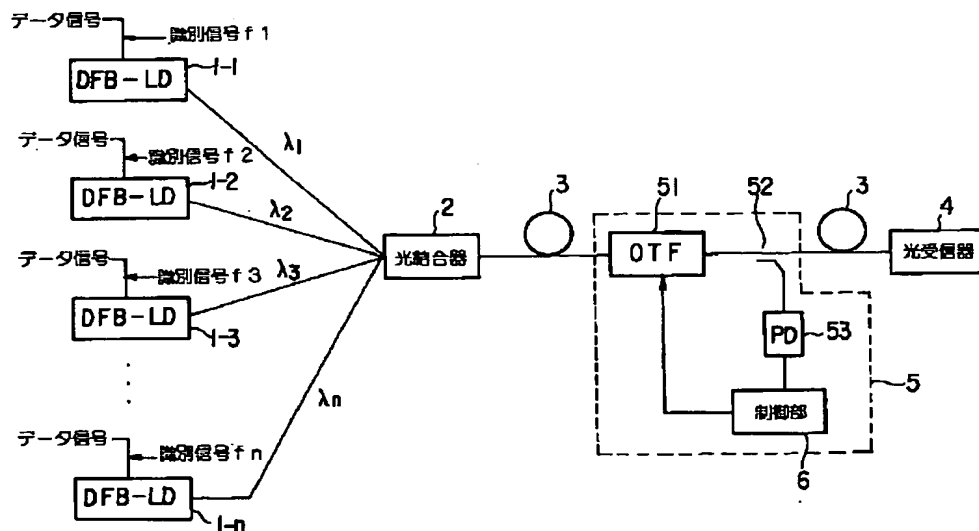
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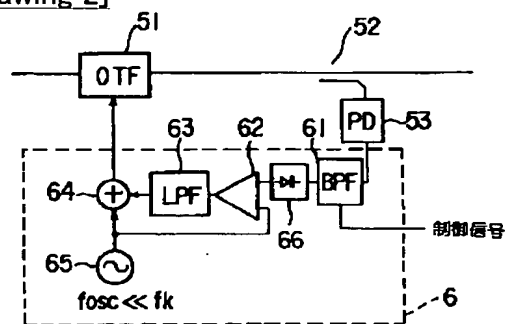
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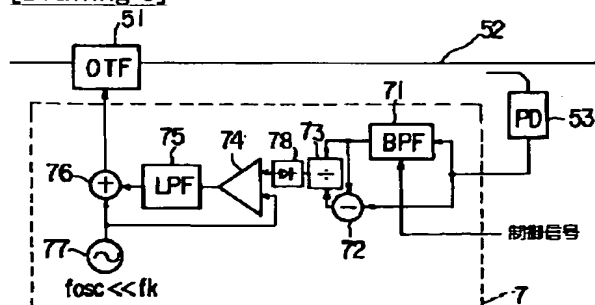
[Drawing 1]



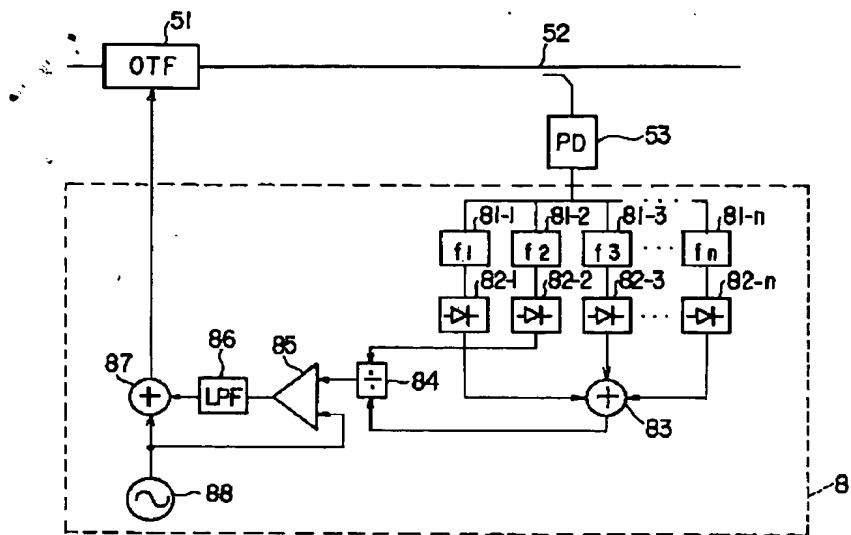
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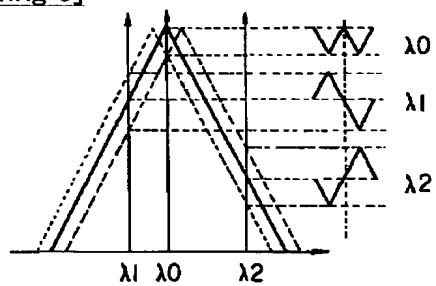
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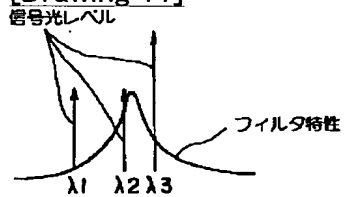
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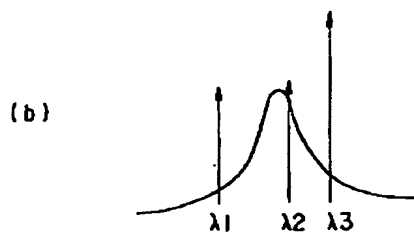
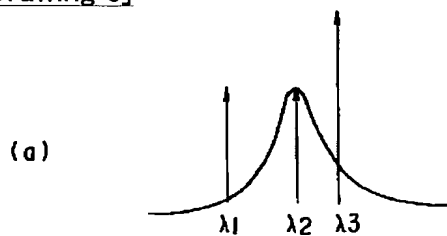
[Drawing 5]



[Drawing 11]

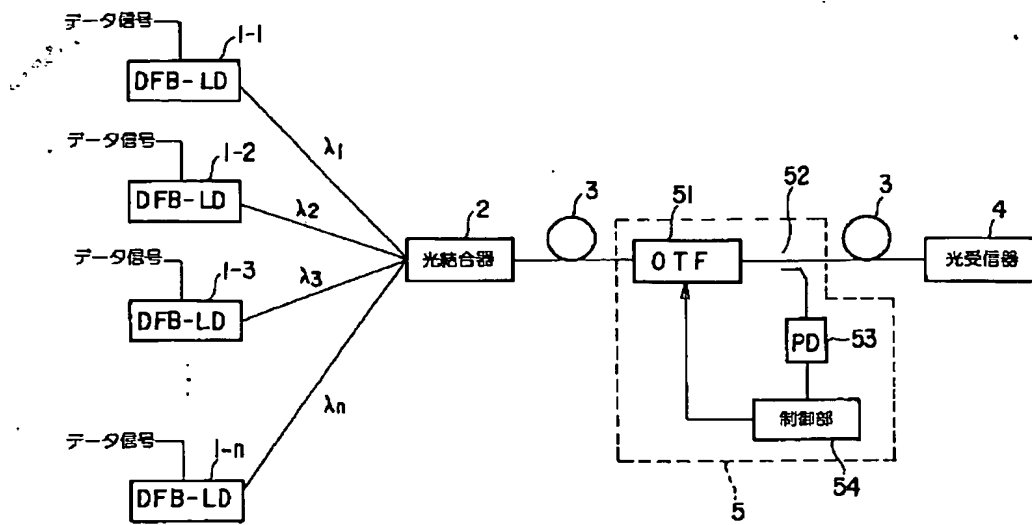


[Drawing 6]



[Drawing 7]





[Translation done.]